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(54) Operating microscope unit with data interface

(57) An operating microscope unit 100 comprising an operating microscope 1 and a carrier unit 4; 4a, 4b, 4c, 4d possesses at least one data interface 5, with the aid of which electric data are outputted or received. The position of the microscope may be found using light diodes 7 and at least one camera 8. Stereotaxis system 10 is shown. Interface 5 may be used for portable computer (11, Fig. 2) to check electric functional elements under program control.

Fig. 1

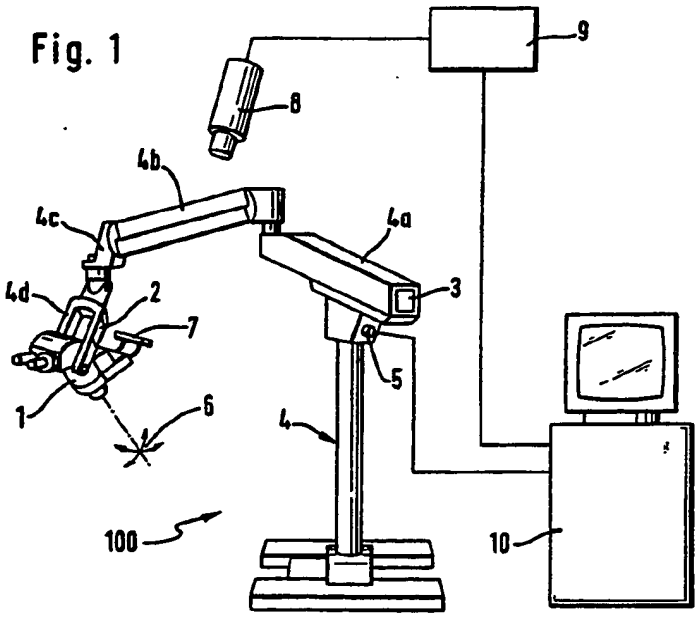

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Fig. 1

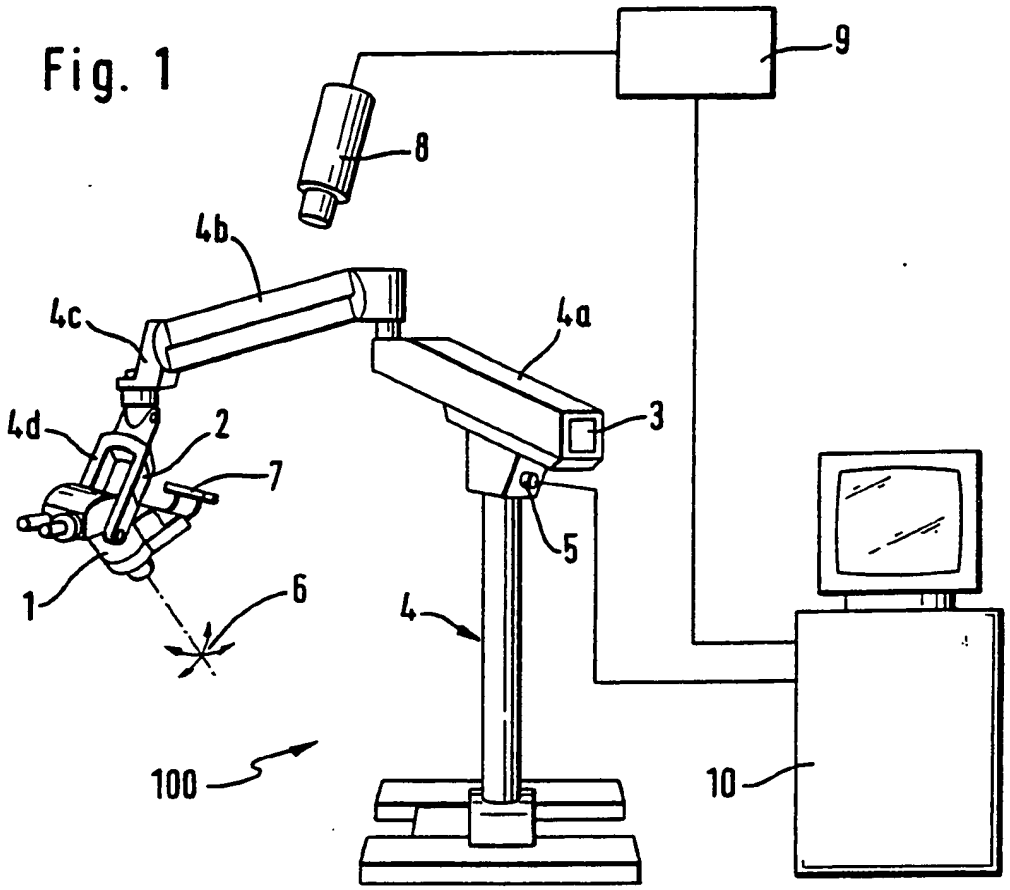
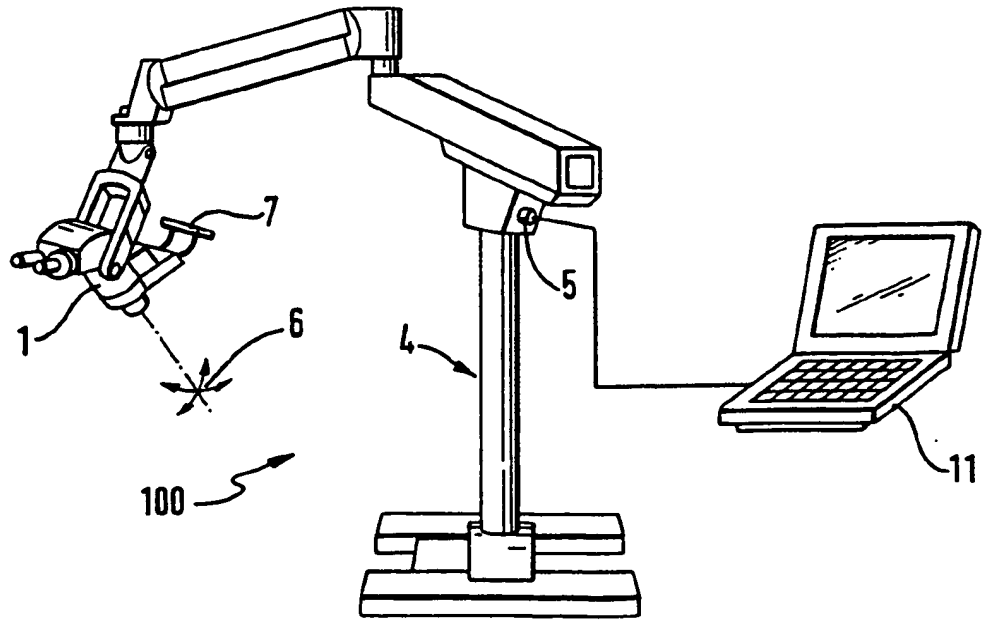


Fig. 2



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Operating Microscope Unit

The present invention relates to an operating microscope unit comprising an operating microscope for microsurgical interventions and a carrier system.

Numerous surgical interventions, especially in opthalmology, neurosurgery and ear, nose and throat medicine, on account of the fineness of the structures, call for instruments for optical magnification of the field of view. In this connection it is necessary for the assessment of the tissue to be operated that it is possible to preselect the magnification, that the focal plane is adjustable and that the visual angle can be freely selected also under sterile conditions. Particularly in neurosurgery, but also in surgery of the mouth, dental and maxillary surgery, facial surgery or other surgical areas it is of importance, moreover, to correlate the viewing locus with other image-providing or locating methods, more particularly computed tomography (CT) or magnetic resonance tomography (NMR).

It is known to employ special operating microscopes which, in conjunction with their carrier or supporting systems, i.e. floor stands, wall mountings or ceiling suspensions, form a functional unit. However, the correlation of the seen image with CT and NMR apparatuses has up to now not been satisfactorily resolved. Likewise the danger exists that, when an operating microscope unit fails during an operation, grievous harm results for the patient.

As a rule, operating microscopes possess motor-driven functions that can be operated by means of pedal switches and/or manual switches, such as zoom, focus, X and Y movement, canting and inclination. Over and above that, they may comprise further mechanical or electrical adjusting means and triggering or relasing mechanisms for the expanded positioning

or manual adjustment. These adjustment means, such as motors, magnets and suchlike and possibly sensors are triggered direct for the feedback information by means of the carrier or supporting unit, such as floor stand or ceiling unit.

The DE 37 97 871 describes a method for the location of structures from CT photographs, in which case an instrument is guided on an arm provided with angle indicators, whose position makes a localization of the instrument point possible. However, the method is not applicable to operating microscopes since, with a variable focal length and magnification, the correlation with the CT is lost.

The DE 41 34 481 describes an operating microscope for the computer-assisted stereotactic microsurgery and a method for its operation, in which case an additional device for the operating miscroscope is provided which actively determines in accordance with the triangulation method through the front objective the focussing plane and magnification and passes the same onto CAS systems. According to this an optical positioning system for operating microscopes with an indication of the parameters through the ocular is known. However, the identification of the focal plane is effected in a costly way by means of an auxiliary means and further parameters for the identification of the locus are not contributed or are contributed in a different manner. With this the system cannot be universally connected with a CT system. General functional parameters, e.g. for the monitoring of the system, cannot be read out.

Also the method and equipment described in the US 4,722,056 connects an operating system in a data composition with a CT scanner and further systems. Since, as already explained in the foregoing, specialized overall means are involved it is impossible to take further improvements of the operating

method into consideration. In addition, the system is costly and cannot be universally employed or applied. A preventive error indication is likewise not taken into account.

The technical problem of the invention is to provide, with simple means, an operating microscope unit of the type described in the beginning which is capable of interacting with different CT and NMR systems and which, over and above that, renders possible a preventive diagnosis of the instrument.

This technical problem is resolved according to the invention by means of the features stated in the Claim 1.

According to this the operating unit is provided with at least one data interface, by means of which the electric data are outputted or received.

In accordance therewith an operating unit with a microscope having integrated microprocessor-aided processing electronics is provided which, via a bidirectional data interface, communicates with the supporting system or carrier unit by means of instructions and data feedback reports and which effects internally a series of additional tasks, such as controls, monitoring and automatics, such as focus compensation, automatic speed control and homing. Consequently, an access to these microscope-specific optical and mechanical data and the control of the microscope by means of an external data interface, as well as indications as to specific application possibilities are possible.

In modern operating microscopes the triggering of the servomotors for the focal length adjustment and the XY movement is effected by electric signals. When making use of digital control signals via RS232 data lines in connection with stepping motors or DC motors having coupled sensors as actuating mechanisms it has now turned out that the position of the optical

components are already definedly established and can be read out by means of the same data line. The position can be maintained by a simple conversion. With this, additional positioning components become superfluous.

Stereotaxis instruments are known which, with the aid of optical triangulation, magnetic fields or pertinent ultrasonic methods are able to measure the position of an instrument point and its direction in space relative to reference points on the body of a patient and to correlate the same with tomogram sections. With this, e.g. by probing with the instrument, the distance from a tumour and the split images can be seen vertically and parallelly to the instrument axis from a CT scan. While for the determination of the space position and space direction of an operating microscope the same, e.g. triangulation can be performed by mounting the light transmitters on the microscope instead on the instrument, the position of the focal plane and the magnification factor still have to be taken into consideration in order achive a correspondence of the CT image to the image seen through the microscope. The data interface provided according to the invention is able to make this possible in a particularly economical fashion.

The special advantage of the data interface resides in the possibility of connecting several commercially available stereotaxis systems to the operating microscope. By means of simple adaptations of the software, systems existing at an RS232 interface can be readily adapted. Owing to the rapid progress in computer technology, the adaptation of an operating microscope to future CT systems is in this case of special importance to the user.

The possibility of controlling the operating microscope by means of the data interface is of great importance. By the preselection of a stereotaxis system on the display screen

it is then possible to automatically reach the focal plane, the magnification and, possibly, the position of the operating microscope.

That is why a bidirectionally acting interface is of particular advantage.

Consequently, the operating microscope unit comprises a processing unit and adjustment elements (zoom, focus, X or canting and Y or inclination) as well as, if necessary, optical features such as braking motors or braking magnets or decoupling members, such as, by way of example, gear releasing means. Furthermore, an input possibility, such as a manual switch, may be connected. By means of sensors which are coupled direct or by means of mechanical coupling elements to the adjustment elements, the associated position and the adjustment speed of the respective function for internal control tasks or for higher-ranking purposes can be determined and utilized. By means of a bidiractional, preferably serial data connection, the processing unit is connected with the carrier system and can be controlled by the same with instructions and status reports. For this purpose, as a rule, a microprocessor-aided processing unit is likewise employed which, apart from the microscope control and monitoring, is likewise employed for auxiliary functions, such as, by way of example, the light control and pedal switch processing. The current supply of the microscope and the operation illumination by means of a light guide cable is normally likewise effected by the carrier unit.

The data interface offers the possibility of controlling all functions of the microscope and/or the carrier system and/or to monitor or to extract information of the system for higher-ranking tasks and to process the same further. These advantages can be utilized especially for servicing purposes with a computer or for CAS application (computer-assisted surgery)

in a composite system for the computer-assisted microsurgery. In a further variant, the microscope can also be connected without carrier unit direct to an external computer and controlled.

A further advantage consists in that the interface is well suited for the early diagnosis. A service technician is able to test with the aid of a programmed portable computer all the assemblies to be reached by means of the interface during a service application and thus determine with a minimum expenditure of time and in a readily loggable manner the further operability of the operating microscope unit. A bidirectionally acting interface is in this case of particular advantage since it is thereby possible to selectively extract information relating to the properties to be tested by the program in the porable computer.

The operating microscope unit according to the invention possessing the possibility of a falling back on microscope-owned data offers the following methods of application and is constructed in such a way

- that a data interface is fitted to the operating microscope and/or to the connected carrier system, with the aid of which the functions of the operating microscope and/or of the carrier system can be bidirectionally or unidirectionally controlled and/or information be requested or extracted. This data interface is preferably constructed in the form of a serial standard data interface in conformity with customary standards, such as e.g. RS232, RS422, RS485 for an easier adaptation to commercially available computers. Along the lines of the medical safety regulations, a potential-free separation of the signals is advantageous;
- that for stereostatic microsurgical applications the set focal plane or the effective distance can be extracted via the computer interface which, in the case of an optical

focussing means having a variable focal length, cannot be determined with a spatial position recognition system. This focal plane, in computer-assisted stereotactic systems is required for the definite localization of the microscope image and the correlation of the same with the tomography photographs (computed tomography (CT), nuclear magnetic resonance (MR), etc.);

- that for stereotactic microsurgery applications the set magnification (ZOOM) can be extracted via the computer interface, which can be employed in computer-assisted stereotactic systems for a superimposed representation of the microscope image with the tomography photographs shown on a monitor (computed tomography (CT), nuclear magnetic resonance (MR), PET or ultrasonic photographs;
- that further microscope-specific data such as information relating to position and speed (X, Y, canting, inclination, etc.) and status information and error messages can be extracted via the computer interface;
- that the operating microscope can be definedly triggered via the computer interface in all functions (focus, ZOOM, X, Y, canting, inclination, etc.) and thus be arbitrarily positioned according to external predetermined information. By this it is rendered possible that, in particular for stereotactic microsurgery in accordance with a preoperatively established line of action, the microscope can be telecontrolled by means of the CAS computer and one or several positions in the operating area can be reached automatically and consecutively. Hereby a visual navigation according to tomography photographs is to all intents and purposes made possible, which is very helpful during the operation and for the identification of tumors;
- that the operating microscope and/or the carrier system can be checked and serviced via thecomputer interface for servicing purposes. With the aid of the aforedescribed triggering

and acknowledgement of a function the possibility exists of a comprehensive telecontrolled diagnosis with pertinent logging. The access to a non-volatile describable storage (e.g. EEPROM) in the operating microscope and/or in the carrier system does, over and above that, additionally permit the recognition of errors which occurred earlier and were stored by the internal processing unit. Furthermore, additional operating data and additional information (e.g. data relating to the last check, length of operation, service intervals, equipment configuration, etc.) can be bidirectionally stored or information regarding them can be extracted. Consequently, with the computer interface it is possible to realize a fully automatic test and check sequence by means of a service computer.

Advantageous constructions of the invention are characterized in the subclaims.

Embodiment examples of the invention are described in the following with the aid of the drawings. Thus

F i g. 1 shows a representation of an operating microscope unit with a stereotactic system, and

F i g. 2 shows a service application via the interface.

in the embodiment depicted in the Fig. 1, the operating microscope 1 is mounted on a floor stand 4 with several swivel arms or swivel means 4a,4b,4c,4d, with which it forms the operating microscope unit 100. The position of the focal plane 6 as well as the magnification are determined by optical components in the operating microscope 1 which are moved by servomotors. The triggering of the servomotors in the example shown here is

effected by a processor printed circuit board 2, which is in data communication with a control printed circuit board 3 in the stand. The data bus between the processor printed circuit board 2 and the control printed circuit board 3 continues up to the data interface 5.

Light diodes 7 mounted on the operating microscope 1 can be detected by one or several cameras 8, whereupon , in a unit 9, by means of triangulation, the local and directional coordinates of the operating microscope are established. These values are conducted into the stereotaxis system 10. The unit 9 is in most cases integrated into the stereotaxis system 10 which, after all, is a computer, in the form of a hardware or software module.

For the genuine positional determination of the focal point in the focal plane 6 as well as for the matching of the proportions on the display screen of the sereotaxis system, the relevant values are conducted via the data interface 5 into the stereotaxis system 10. In this connection the depicted disposition is particularly advantageous since the signals used for controlling the servomotors, which are transmitted from the control printed circuit board 3 to the processor printed circuit board 2 constitute at the same time the measuring signal. That is why further sensors can be dispensed with.

According to a further embodiment as per Fig. 2, the entire control of all the electric functional elements is effected by hand. That is why by means of a portable computerunit is possible to check all electric functional elements under program control. Apart from the advantage of a minimal amount of time being used, the safety of the check is increased by a forgetting or misinterpretation being ruled out as well as by a clear loggability.

Claims:

1. Operating microscope unit, comprising an operating microscope (1) and a carrier unit (4),
characterized in that
the operating microscope unit (100) possesses at least one data interface (5) for the output or for the reception of electric data.

2. Operating microscope unit according to Claim 1,
characterized in that
the data interface (5) is constructed in the form of a transmission unit for digital signals.

3. Operating microscope unit according to either Claim 1 or 2,
characterized in that
the data interface (5) is constructed in the form of a serial interface in conformity with the standards RS232, RS422 or RS485.

4. Operating microscope unit according to any of Claims 1 through 3,
characterized in that
the data interface (5) is constructed in the form of a data connector.

5. Operating microscope unit according to any of Claims 1 through 4,
characterized in that
the operating microscope (1) is mounted on a floor stand (4), in that the position of the focal plane (6) as well as the magnification with the aid of optical components in the operating microscope (1) is adjustable, in which case the optical components are moved by means of servomotors, in that, for the triggering of the servomotors, a processor printed circuit board (2) is provided on the floor stand (4) or on one of its swivel arms (4a,4b,4c,4d)

or on the housing of the operating microscope (1) while the processor printed circuit board (3) is in data communication with a control printed circuit board (3) in the floor stand (4) and in that the data bus between the processor printed circuit board (2) continues up to the control printed circuit board (3).

6. Operating microscope unit according to any of Claims 1 through 5,
characterized in that,
on the operating microscope (1), light diodes (7) are disposed that are detectable by at least one camera (8) and in that, for the determination of the operating microscope local and directional coordinates, a control unit (9) is provided which interacts with a stereotaxis system (10).

7. Operating microscope unit substantially as hereinbefore described with reference to, and as illustrated in, the accompanying drawings.

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Patents Act 1977 Examiner's report to the Comptroller under Section 17 (The Search report)	Application number GB 9506661.9
Relevant Technical Fields (i) UK Cl (Ed.N) G2J (J8X); G4A (AUXM) (ii) Int Cl (Ed.6) G02B	Search Examiner MR C ROSS Date of completion of Search 24 MAY 1995
Databases (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii) ONLINE EDOC, WPI	Documents considered relevant following a search in respect of Claims :- 1-7

Categories of documents

X:	Document indicating lack of novelty or of inventive step.	P:	Document published on or after the declared priority date but before the filing date of the present application.
Y:	Document indicating lack of inventive step if combined with one or more other documents of the same category.	E:	Patent document published on or after, but with priority date earlier than, the filing date of the present application.
A:	Document indicating technological background and/or state of the art.	&:	Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
X	EP 0186490 A2	(DU PONT) see especially Figure 1	1 at least
X	EP 0164680 A2	(OLYMPUS) see especially interface 9, Figure 1	1 at least
X	US 5074651	(TOPCON) see especially part 25	1 at least
X	US 4722056	(ROBERTS) see especially column 4 line 27 on	1 at least
X	US 4720804	(MOORE)	1 at least
X	US 4202037	(GLASER)	1 at least

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